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CONTENTS:

Does a Technical Course Educate? PRESIDENT CHAS. S. HOWE 97

The Work of the Bureau of Government Laboratories of the Philippine Islands: DR. PAUL C. FREER 105

Scientific Books:—
Metchnikoff on the Nature of Man: ALEŠ HRDLYČKA. *v. Lippmann's Die Chemie der Zuckerarten:* DR. F. G. WIECHMANN 109

Scientific Journals and Articles 112

Societies and Academies:—
The Research Club of the University of Michigan: PROFESSOR FREDERICK C. NEWCOMBE. *The Torrey Botanical Club:* WILLIAM T. HORNE. *The Science Club of the University of Mississippi:* ALFRED HUME .. 112

Discussion and Correspondence:—
A Case of Plagiarism: G. K. GILBERT 115

Special Articles:—
The Ascent of Water in Trees: PROFESSOR GEORGE MACCLOSKIE 116

Botanical Notes:—
The Number and Weight of Cottonwood Seeds; Weight of Dandelion Down; Tendrils of Virginia Creeper: PROFESSOR CHARLES E. BESSEY 118

Field Work for 1904 of the Division of Geology and Paleontology of the United States Geological Survey 119

Baron Toll 123

Scientific Notes and News 123

University and Educational News 128

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*DOES A TECHNICAL COURSE EDUCATE?**

BEFORE we can answer the question 'Does a Technical Course Educate?' it is necessary that we understand what education should mean. We do not need to trace this word back to its root, to find its derivation in some ancient language and to learn its exact meaning in that tongue, but rather to find what it has stood for in the thoughts of men, what processes have been necessary to produce it and what its value has been to those possessing it. If we take a brief look at some of the methods and ideals of education in the past we may receive light upon its proper meaning to-day. Education is for the benefit of the individual or for the benefit of the state. In Persia, in Egypt, in Greece, in Rome, the individual was nothing, the state was everything. The hopes, the desires, the wishes of men were not considered; the growth and prosperity of the state were paramount. In Persia and Sparta education was for war. The education of the body was for the many; the education of the mind for the few. Aristotle was the first to teach that the ultimate end of education is the ability to enjoy the blessings of peace.

Society derives its ideals of education at any epoch from the limits of knowledge at that epoch. A man can teach only what he knows. If he knows but little he can teach but little; if the sum of human knowledge is small, there is but little to be taught, although there is much to learn. In the early days of Greece the Trivium and the Quadrivium embraced all knowl-

* Inaugural address of the president of Case School of Applied Science, May 11, 1904.

edge. Grammar, rhetoric and dialectics were taught to all who entered the schools; arithmetic, geometry, astronomy and music were reserved for the more advanced, who were few in number. The former were language studies; it was understood then as now that language, one's own language, is the most important subject for the beginner to study. It is a significant fact that the Greeks studied no language but their own. In Rome, too, all knowledge was found in the Trivium. Having little else to study, the Greeks and Romans each built up a language and a literature which have never been surpassed, the former for its scientific accuracy, the latter for the beauty of its thought and the elegance of its diction. The sciences of the Quadrivium were slowly developed by the Greeks, the Romans and the Arabs, and in the case of geometry and music were brought to a high degree of perfection. But science in these early as in later days met with much opposition from those whose chief study was language or philosophy. Socrates believed that the study of science was profitless and wrong, 'for he did not think that such matters were discoverable by men, nor did he believe that those acted dutifully towards the gods who searched into things that they did not wish to make known.' Locke must have been reading Socrates when two thousand years later in his 'Thoughts on Education' he said: "Natural philosophy as a speculative science, I imagine we have none, and perhaps I may think I have reason to say we never shall be able to make a science of it. The works of nature are contrived by a Wisdom and operate by ways too far surpassing our faculties to discover or capacities to conceive, for us ever to be able to reduce them to a science." During the dark ages ignorance and superstition blotted out all education and all desire for education among European peoples, the Moors of Spain alone excepted. Some remnant of learning remained in the monasteries, but it was only enough to accentuate the intellectual darkness which enveloped the nations.

The rise of the mediæval universities marked the revival of learning. In Paris, Oxford, Bologna, Prague, Vienna and many other cities were established great schools of the liberal arts, law, medicine and theology. The Trivium and the Quadrivium were still the principal subjects studied. Learning was surrounded by a high wall and the only entrance to the sacred enclosure was through the Latin gate. All books were in Latin; Latin grammar and rhetoric were first studied. Pupils slowly repeated grammatical rules recited by the teacher and then learned by rote the works of the classic authors. Dialectics next received attention and pupils spent years in wrangling in Latin over disputed constructions in grammar or knotty points of law and theology. There was no vernacular literature. The lore of the ages had been concentrated in Greece and Rome, and though these countries were now shorn of their ancient splendor, they still dominated the world of learning. This was but natural, as the languages of western Europe were crude and unformed, while the classic tongues were polished and refined. Latin was the language of the educated; a knowledge of it opened the door to all art, literature and science. It was the badge of an aristocracy, a secret brotherhood of learning. Those within the order had certain privileges not possessed by others and they looked down upon those outside their ranks. The education of this period lifted men out of the ignorance in which they had been engulfed for centuries and gave them all the knowledge of the world. This knowledge was centuries old, it is true, but it was fresh and new for those who had rediscovered it. They churned it over and over, pressed it into

new forms and expressed their wonder and admiration at the beauty they found in it. But as a rule they made no effort to improve upon it, to discover new truths or to impress their own thoughts upon the world. The student who receives all his knowledge in a foreign tongue, different from the language of his every-day life and thought will seldom add to that knowledge. Truth reveals itself to him who diligently seeks it at all times and places, whose every thought is given to the search and whose mind is open to receive it even when engaged in the most commonplace affairs of life. A man living in his native country thinks in his own tongue; if there are no words in that tongue to express the ideas which come to him, they are apt to pass unheeded.

The dawn of the renaissance brought new factors into the intellectual life of Europe. The several languages settled into fixed forms and became more refined. Reading, writing and arithmetic were taught in the mother tongue and so education spread among the common people. Scholasticism gave place to classic culture and the study of history, philosophy and mathematics became more common in the universities. Latin was still the language of learning and the classic authors the chief source of culture. During the centuries which have followed, the changes in methods and subjects have been slow. In the past the teacher has been the most conservative of men. He has taught that which he himself learned and has followed the methods of his teachers. Education has been a rigid mold, a cast-iron form into which all were pressed and came out exactly alike. All culture and the greater part of learning were embalmed in the classic tongues and these mummified forms were thought to be eternal and unique. But the spirit of scientific enquiry has shattered the mold and one subject after another has been added to the curriculum of the university. Men have come to see that language is a means and not an end; that the true subject for study is not grammar, but the universe. It has taken many centuries to show that education is many-sided and of many forms. Until within a few years the curriculum at each college has been fixed—so much language, so much mathematics, so much philosophy, so much or rather so little science. The student who had no taste for mathematics was forced to do as much as the one whose taste was for formulas and numbers; he who disliked language must cram Latin and Greek for years or he could not be called an educated man. But new ideas and new methods have come within the last half century. It has come to be recognized, the advocates of the new method say, that all men are not alike, that what is suitable to develop the mind of one will not answer for another. Individual tastes and capacities have been at last respected and no student is now forced to try to become a linguist or a mathematician or a philosopher or a scientist or a weak combination of them all against his wishes. The educational pendulum has swung from the conservative to the radical side and now the student may decide to specialize in chemistry, or logic or Anglo-Saxon before he knows what these terms mean. In some respects we have reverted to the methods of the mediæval universities, for now as then a student may graduate without much knowledge of his mother tongue.

Which of the methods so hastily mentioned has produced true education and which results shall we use to settle the question under discussion? Is the true method that of the Chinese which taught a worship of ancestors and a reverence for antiquity; or that of Persia and Sparta which prepared men for war; or that of Athens, which in the words of Milton

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'taught men to perform justly, skilfully and magnanimously all the offices, both public and private, of peace and war'; or that of ancient Greece and Rome which developed an almost perfect language and literature and produced an art and philosophy which have been the admiration of the ages; or that of the mediæval universities which revived a part of the old learning but added nothing new, or that of the centuries succeeding the renaissance which laid chief stress upon classic culture but developed a vernacular literature and gave birth to the sciences; or that of the present with its tendency to absolute freedom in the choice of studies? Among this diversity of methods and results it is difficult to select a criterion by which to settle our question. Many definitions of an educated man have been given, but among them all I know of none that will appeal to a scientific mind like that of Huxley. He says: "That man, I think, has a liberal education, whose body has been so trained in youth that it is the ready servant of his will, and does with ease and pleasure all that, as a mechanism, it is capable of; whose intellect is a clear, cold, logic engine, with all its parts of equal strength and in smooth running order, ready, like a steam engine, to be turned to any kind of work and to spin the gossamers as well as forge the anchors of the mind; whose mind is stored with the knowledge of the great fundamental truths of nature and the laws of her operations; one who, no stunted ascetic, is full of life and fire, but whose passions have been trained to come to heel by a vigorous will, the servant of a tender conscience; one who has learned to love all beauty, whether of nature or of art, to hate all vileness, and to esteem others as himself."

Without attempting to rival this and other definitions, I may say that considering the subject from an intellectual standpoint only, if we are to train educated men I believe we must teach our students to know, to search, to think. To know—what? This is the question which our institutions of learning have been trying for many centuries to solve. When all knowledge was embraced in the Trivium, the problem was easy. He who mastered the Trivium was educated. Now the very extent of knowledge makes the problem difficult. The chemist, the mathematician, the botanist, the philologist, each declares that unless a man knows something of his specialty he is not broadly educated. Enough is known in mathematics to keep a student busy for his entire life, and the same is true of all other branches of learning. The poor student is urged on by one teacher and conditioned by another, is given lessons by each long enough to consume all of his study hours, and wonders why he is obliged to try to master things he does not like; or turned loose to browse as he pleases, seeks too often the easiest paths and gains but one side of an education. No man can know all there is to know. However great his attainments, however broad his sympathies, however brilliant his intellect, he can only prospect a little on the mountain of knowledge. Is it necessary to know all? Are there not some things a knowledge of which is necessary in education, and others which can be left to the individual taste? I believe that in the future all colleges will answer this question, as some have already done, in the affirmative. Those which still adhere to the required curriculum must permit a certain amount of natural selection, while those which offer almost absolute freedom in choice of studies must place more restrictions upon youthful tastes. And what are these necessary subjects which all should master? First and foremost is one's own language. The ability to speak and write the mother tongue should be insisted upon

in every scheme of education. It is evident that the secondary schools can not complete this work. The entrance examination papers in every college show that the students know very little about rhetoric and composition. It is a slow process to teach a student to express himself clearly, concisely, elegantly. Cato said, 'Get a firm grip on the matter and words will follow fast enough.' This may have been true two thousand years ago, but either it is not true to-day or our students do not conform to the condition. The English language should be studied from the time the student enters college until he leaves if he is to be master of his own tongue. Modern languages, two at least, should also be insisted upon. Knowledge is not circumscribed by boundary lines nor learning located by latitude and longitude. No one country, no one language contains all the educated man should know. The study of literature will naturally be coincident with the study of language. The great thoughts of some of the great men of all ages should be known and understood. The range of reading should be wide, the critical study of style and content be confined to a few authors. History should be included in the list of necessary subjects. The history of one's own country should be well known; the history of other countries restricted to the most important events. Most of our college students have not studied American history since they were in the grammar schools and few if any of our colleges make it a required part of the curriculum. Can any knowledge be more important to the educated man than the history of his own country, and is the amount acquired in the grammar school before he is fourteen years old sufficient? History should not be confined to great events or to the manners and customs of the people, but should include past and present politics. Many years ago there was inscribed upon the walls of the historical rooms of Johns Hopkins University the words of Freeman, 'History is past politics; politics is present history.' Past and present political parties, the principles they have or do stand for, the success or failure of their policies and their effect upon the welfare of nations, may well be required. The study of civil government is closely allied to the preceding. Very few of our college students can describe the government of the cities in which they live or tell the names and functions of the several courts of justice in their native states. Economics, though not a required study in most of our colleges, is one with which all should be familiar. The functions of land, labor and capital, the relations of labor and capital, the nature of supply and demand, money, production, distribution, wages, rent, taxation, tariff, should all be understood. Philosophy and ethics should, I think, receive a small amount of the time devoted to required studies. Nor can a man be called educated unless he knows something about art. The several schools of painting and sculpture, the great paintings, the great statutes, the masterpieces of architecture, should all be familiar to the student. Chemistry and physics have made the wealth of our modern world, have revolutionized our mode of living, have dictated the policy of nations and have changed the course of history. Yet how few of our institutions of higher learning require either of them except as entrance subjects? There is very little in mathematics which is necessary for the educated man to know. Arithmetic, algebra and geometry are studied in the secondary schools and from the standpoint of knowledge nothing else need be required.

Botany and astronomy are likewise necessary. The educated man moves among the trees, the plants, the flowers, by day, and

sees above him the planets and constellations by night. No more than in the days of Job may he bind the sweet influences of the Pleiades or loose the bands of Orion, but he should know the north star when he sees it and be able to tell why the Copernican theory is true.

Am I requiring the educated, the broadly educated man to know too much? He can learn something of all these subjects during his college course and yet have a great deal of time left to follow his own individual tastes. The standard by which to judge the technical course, to ascertain its deficiencies, must be broad. In these days of telephones, electric cars, X-rays and the wireless telegraph ought we to call a man educated if he has not given considerable time to the study of physics? Ought we to call a man educated if he does not know the history of the great political parties and our methods of government? Ought we to call a man educated if he moves among the phenomena of nature by day and by night with no more knowledge of them than if he were blind? And yet we are graduating from our colleges many men who know little or nothing of any of these subjects and we do call these men educated. The educated man is to live in his own generation; he is a citizen of to-day, not of yesterday or to-morrow, and he should know those things which will fit him for the business, social and political life of his own time.

To search. However much a man may know, there is yet more to be known. It is not necessary for the educated man to know everything, but it is necessary for him to be able to find anything in the realm of knowledge. He should be taught how to use indexes, dictionaries, encyclopedias and other books of reference; libraries, art galleries and museums should open their stores to him when he bids them. Every one knows how to look up a word in a dictionary or an article in an encyclopedia, but the systematic use of all sources of information is rarely taught. The student has not been fully initiated into the mysteries of his order until he has been taught to search. Then the freedom of the scholar is his and the universe lays its treasures at his feet.

To think. The most important and the most difficult! Man may be by nature a thinking animal, but if so, he does his utmost to conceal his powers. The faculty of original thought never comes to most men. In childhood we must accept what is told us, and we become so accustomed to receiving our ideas from others that many of us never outgrow it. We believe without question what we read in books, magazines and newspapers, what we hear in the classroom and from the pulpit and platform. But the broadly educated man must think for himself. The mind, like the body, should be put through certain exercises to gain strength. Mathematics and the ancient languages, which have been omitted from the list of things the educated man should know, are among the most powerful influences for training the mind. This is why they have held such an important place in the curricula of our colleges. But they are not the only subjects which will stimulate mental thought and teach the mind self-reliance. A man may grow strong by rowing, by using chest weights or by chopping wood. Any one of these will stimulate the nervous system, send the blood to all parts of the body and keep every muscle in a healthy condition. The proper study of chemistry or philosophy or thermo-dynamics will have a like effect upon the mind. But there are many muscles in the body; if a man uses his biceps only, he will not grow strong in the legs. And there are many powers of the mind. If the intellect is to have all its powers of equal strength, as Huxley advises, the man must be taught to think in

more than one direction. He must study language, mathematics, science, philosophy, not for knowledge only, but for discipline.

If these requirements, which, I confess, have a large personal equation, are necessary to produce education, does a technical course educate? Perhaps it would be proper first to inquire: do our colleges and universities educate? Do they teach their students to know, to search, to think? Have they not gone too far in the direction of allowing any man to study anything? But it is the technical school and not the college which is under discussion. The technical school is a professional school and its duty is to train its students for active professional life. It is not a university nor a college. Its aims and its methods are different from either. Its business is to teach, and if it does not teach, it has no excuse for existence. In a university, the faculty are expected to do little teaching and much research work; in a technical school they are expected to do much teaching and little research work. Research and expert work are advisable to a limited extent—limited, however, only by the time and strength the instructor has left after his regular work is done. They should be encouraged by the authorities in every possible way under the above restrictions. Research work is the legitimate outcome of learning to think. He who possesses the power will find ways and means to use it. Coal burned in our furnaces yields but a fraction of its energy in useful work; the sun's rays shining upon the roofs of our manufactories have stored up energy enough to light and heat the buildings and to operate all the machinery within, but we use none of it. Surely there is opportunity for original work by the engineer. The community has a right to demand that the professor in a technical school shall do expert work. The knowledge he possesses, the laboratories and apparatus at his command should be for the use of the community whenever this will not interfere with his first duty as a teacher.

Engineering is a learned profession. Schools of law, medicine and theology do not attempt to give a broad education. They either require a liberal training for admission or they admit students from the secondary schools. In both cases the course of study is the same. The engineering student usually comes directly from the secondary school. It would be possible to give him drawing and shop-work at once, to furnish him with tables and empirical formulas and have him begin technical work immediately. But this would make him a mere machine and not an educated engineer. The technical schools recognize that they are training for a learned profession and require the students to give the greater part of their time for two years to liberal studies. The purpose of the Roman schools was utilitarian, but they furnished a sound training. The purpose of the technical schools is likewise utilitarian, but they give a broad and liberal education as far as they go. English is thoroughly taught during the time devoted to it. The training in modern languages is good, although its chief aim is to teach the students to read scientific books and periodicals. Mathematics is thoroughtly taught; it has to be for it is the basis of all engineering work. Physics and chemistry are required to a greater extent than in any college. Economics is required in some and offered as an elective in many others. The technical student is taught to search. Books of reference, periodical literature, proceedings of societies and government reports are made a part of his education. And an effort is made to teach him to think. The connection between theory and practice can only be learned by vigorous mental effort. It is only by right thinking along scientific and mathematical lines that the

student learns to transform a theorem into a dynamo or a formula into a compound engine.

And thus I am led to the conclusion that a technical course does educate to a limited extent. It teaches the student to search and it teaches him to think; it teaches him some of the things that an educated man should know, but it does not teach him all that an educated man should know. It would be much better if our technical graduates were broadly educated men as well as trained engineers, if they had received a college training before entering upon a technical course. In a university it would be easy to require this. Two courses would be open to the student. He could complete his college work with no reference to technical subjects and then enter the engineering department; or after completing those subjects which are considered necessary for a liberal training, he could choose a part or the whole of his electives in the technical school. In the former case his combined college and professional course would require six or seven years; in the latter case five or six years. Some of our universities have such a requirement and I am glad they do. I believe the student should be trained to know, to search, to think before he enters the technical school. During his whole life he would have a broader outlook, a deeper sympathy with men and events, a greater influence upon the community. I am not sure that he would be a better engineer.

But however desirable such a combined course may be, it is not possible at present to make the whole or a part of a college education a requisite for admission to the technical schools. In 1902 there were graduated about 1,600 engineers; there was a demand for about 4,000. If a college diploma were required for admission, the number of graduates would not be more than a quarter as large as now. Even if it were possible to make such a requirement, I do not think it would be wise to do so. Whatever may be our opinion in regard to the best course of study, we must take into account the wishes of the student and the average technical student does not wish to go to college. He thinks the course of study too long and too expensive. He would be forced to give up all hope of an education if six or seven years were necessary to obtain it. A man's first duty is to make a living for himself and for those dependent upon him. The average boy—your boy and mine—has his own way to make in the world. He will be given an education but after that he must take care of himself. The technical course, if understood, is wonderfully attractive to the boy. The Talmud says, 'the end of learning is doing'; the end of a technical course is doing and the average boy wants to do something. He knows he can make a living as soon as he graduates. It is not strange that he wishes to begin this work as early as possible and to finish it as soon as consistent with thorough preparation for professional duties.

In conclusion I would say that the technical school has three great duties to perform in education.

First: To maintain a high standard in its professional teaching. It was created to do this work. Technical training is education of a high order, although not liberal. The mistakes of the engineer are destructive to property and sometimes to human life; hence the standard of teaching should be high.

Second: To see that it does not degenerate into a trade school. The student will go into practical work when he graduates and so there is a tendency to give him more and more practical work in the school. There is no objection to this, provided it does not interfere with the broader studies already described. If the liberal studies

usually given are dropped, the technical school will become a mere shop or drafting room.

Third and last: To encourage those young men who are planning to enter technical work to first obtain a broad and liberal training to the end that they may be better citizens and wield a greater influence in society, the community and the state.

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THE WORK OF THE BUREAU OF GOVERNMENT LABORATORIES, OF THE PHILIPPINE ISLANDS.

IN an article published in a former number of SCIENCE* a short résumé of the plan which had been devised to further scientific work in the Philippine Islands was given, together with an outline of what the bureau of government laboratories expected to do in the future. At that time the organization had only begun, and the scientific work which was being performed was limited. Plans for a new building were under way, and an attempt was being made to obtain a large corps of scientific workers to carry on the necessary research work for the government, but only a few men were actually on the ground. Two years have now elapsed, and it is possible to speak with certainty of the results accomplished, and with confidence of the scientific scope of the future.

The new laboratory structure, planned carefully in the beginning, is now approaching completion, and the adaptation of this building to the needs of the varied scientific work to be carried on can be appreciated. The branches of chemistry, bacteriology, pathology, botany, entomology, as well as the preparation of prophylactic and curative serums, have been amply provided for. Although it can already be said that each room will be occupied, there will, nevertheless, be no crowding for years to come, and only two or three workers on specific subjects will need to occupy one room at a time. The building has been somewhat delayed, not only owing to uncertainty as to its location, but also because of lack of some of the materials necessary for its construction. The machinery which is being installed will be ample for the purposes of laboratory technique. It will supply compressed air, vacuum, steam and steam exhaust, as well as electric power in all of the rooms and at all of the desks where such aids are necessary, and the pressure, mechanically provided, will give an ample water-supply for all parts of the building.

One difficulty encountered in laboratory work in the Philippine Islands has been in the gas-supply. Owing to the nature of oriental coals, it has not been profitable to construct municipal gas plants. The price of the coal which can be obtained is high, and the products are not such as to yield large quantities of illuminating gas, and obviously the importation of the proper materials from Europe or the United States is out of the question. Gasoline, which is used so frequently for laboratory supply in other countries, is both expensive and of an inferior quality, and for this reason the bureau has adopted the method of preparing its gas from cocoanut oil. Heavy cast-iron retorts are heated to redness in furnaces, and cocoanut oil is then slowly dropped in. The product is a very high quality of illuminating gas with very little tar and a proportionately small residue in the retort. In the new building a battery of three of these generators will be installed, and provision will be made for the putting in of a fourth unit, the capacity of the gas-holders being 2,500 cubic feet.

The bureau, as at present organized, is separated in three buildings, one for the work in chemistry and botany, another for

* SCIENCE, October 10, 1902.

biology and the allied work, including entomology, and the third in conjunction with the preparation of serums. The aim of these various divisions has been not only to provide for the immediate necessities in the way of chemical analysis, diagnostic work for the hospitals and prisons, and the preparation of prophylactic serums, for which an urgent demand existed, but it has also endeavored by its research work and publications to help the government in its knowledge of existing conditions, and to point out methods for advancement, not only in matters of hygiene, but in the development of natural products and in the study of diseases of men and of animals.

As is well known, one of the most serious problems which confronted the government of the Philippine Islands was the loss entailed by diseases of draft animals, which in times past has been so serious as practically to paralyze agricultural industries in certain districts. The laboratories were called upon, not only to give advice as to the best means of preventing the further spread of these disastrous maladies, but also to prepare for the elimination of dangerous contagious diseases where they existed. Therefore, in January, 1903, as soon as the serum laboratory was organized as part of the bureau, an insistent effort was made to prepare larger quantities of rinderpest serum, and to gather a corps of veterinarians with their assistants, who would be able to visit all parts of the archipelago for the purpose of inoculating against rinderpest the herds still remaining.

From a small beginning, with a few animals, the rinderpest serum herd has been increased to a number varying from fifty to seventy-five animals, according to the needs of the service, and a steady supply of non-immunes for the purpose of furnishing virulent blood has been obtained from Shanghai. The demands have been very large, for not only has serum been furnished to the veterinarians in the islands, but when the government decided to purchase inoculated draft animals in China for the purpose of restocking the islands, the burden of the immunization and hygienic care of the animals upon their arrival in Manila at first was thrown entirely on the laboratories, and the shipping of at least one half the necessary serum to Shanghai has been undertaken throughout the life of the contract.

The results in the islands have been most gratifying. The veterinarians have met with invariable success wherever they have gone, and the conditions have become such that rinderpest is non-existent in by far the greater number of provinces, and it is easily controlled in a short time wherever it reappears. The method of immunization used has been that of simultaneous inoculation.

The demand for vaccine virus has been very great, and the laboratories have been compelled to purchase a large number of calves for this purpose. These animals have, as a rule, when their quality would warrant, been sold to inhabitants intending to engage in the raising of cattle,* and in that way, after having been used for vaccine purposes, they are of continued benefit in the restocking of the archipelago. Of course all of these animals are immunized against rinderpest before leaving the institution. Plague prophylactic has been supplied to the board of health in quantities sufficient for all purposes, and its effectual use has been one factor in bringing down the number of plague cases to such a degree that the Philippine Islands may now be declared to be practically free from this disease. The rats caught by the board of health were examined for plague in the biological laboratory, and the results ob-

* Tuberculosis has never been encountered in examining the calves used at the laboratory.

tained were used in locating plague houses.

The cholera epidemic, which began on March 20, 1902, and which was in the ascendent for six months, naturally threw a large burden of work especially on the biological laboratory, whose etiological studies, diagnoses and autopsies were the basis of action by the board of health. The large amount of routine work entailed thereby interfered with extensive investigations in the bureau, but the results have warranted the time expended.

The attention of the biological laboratory has also been devoted to surra, a disease generally attacking horses, and which has caused many deaths in the islands. The extensive investigations of the bureau in this direction have been published in a monograph. The results, just as in the history of past efforts in this direction, did not lead to a method of cure, but they have nevertheless extended our knowledge so as to prove that the disease may be harbored by rats and transferred by lice and flies, that it is not conveyed by food, and the researches have led to advice as regards detection of affected animals and their destruction. It has also been shown that the native water-buffalo, termed carabao, is very susceptible and must be considered as an important factor in the extension of the infection. Surra infection has been one of the greatest difficulties encountered in the importation of draft animals from China, and the isolation of large herds and the endeavor to prevent its spread has been a task of no little magnitude.

The biological laboratory has also undertaken investigations on the all-important subject of human diseases, and is now preparing for publication work on a method of protective inoculation against Asiatic cholera and on amœbic dysentery, and it has been fortunate enough to encounter and describe some new diseases. Research on beri-beri, plague, cholera, trypanosomiasis, etc., is also in progress.

The veterinarians and inoculators of the insular government, with the exception of the ones necessary for actual laboratory work, have now been placed in a corps of veterinarians under the direction of the board of health, of which body the superintendent of government laboratories is a member, so that in the future the laboratories can, to a much greater extent, assume their normal function of furnishing prophylactic serums and diagnostic work, while the actual details of inoculation, isolation and destruction of infected animals will become part of the duty of the board of health. By this improvement the directors of the biological and serum laboratories and the employees in those divisions will be able to devote a larger amount of time to investigation and research in the lines which properly fall within their scope.

As the policy of the government was to provide laboratories which would be of maximum usefulness to the people, it was decided more than a year ago to permit the general public to call upon the bureau for analytical and diagnostic work at reasonable and fixed charges to be imposed in return for the results obtained. This privilege has been taken advantage of by the public to a considerable extent, and a large variety of work has come to the bureau as a consequence. The other bureaus of the government, such as the custom-house, bureau of agriculture, bureau of mines, etc., have occasion to use the laboratory very frequently to obtain analytical results of all kinds, and as a result the chemical laboratory has gradually developed a corps of analysts who are accurate, careful and capable of handling the work. In addition an endeavor has been made to begin systematic investigations, and the first results of such endeavor have appeared in a bul-

letin published by the bureau on the subject of 'India-rubber and Gutta-percha.' At the same time work has been steadily carried on in relation to the important cocoanut-oil industry, and results are gradually being obtained which in the near future will warrant the publication, from the commercial side, of accurate and complete information.

The field in the islands is very large and many topics remain to be handled. Especially is this true of many of the medicinal plants of the islands, of which very little is known, of the gums and resins, and of essential oils.

The corps of botanists, now consisting of four men, has, as is necessary in a new country, been devoting its first attention to the preparation of an adequate herbarium, and the collection now contains over ten thousand numbers. Materials have been sent to various countries for identification, but with the laboratory facilities now on hand much of this work is being done here. The time will soon come when this herbarium will have assumed sufficient dimensions to warrant individual investigations with it as a basis, and in furtherance of this plan the laboratory, in conjunction with the forestry bureau, will establish a botanical garden at Lamao, across the bay from Manila. When this is accomplished, the field of work will be open for the plant physiologist and mycologist and work can be steadily pushed. The results of the botanical work up to the present have been published in two bulletins, with a third in the press. The entomologists have been more handicapped in their work of identification than the botanists, as the field in the islands is practically new, and the species and genera obtained are, to a large extent, undescribed. The work of securing an adequate collection has been steadily pushed, however, and at the same time the economic side has not been lost sight of. So far the entomologists have published two bulletins, one on 'Insects attacking the Cacao Plant,' and another on the 'Australian Cattle Tick,' which is present in the islands and capable of transmitting Texas fever.

The library has steadily expanded, and although difficulty has been encountered in obtaining complete sets of some publications, the chief ones in all scientific branches now represented in the bureau have been purchased and are on the shelves, so that literature for extensive research work is available.

In all, the progress for the past three years has been most satisfactory, and the wisdom of the government in establishing one central laboratory institution, which could carry on all lines of necessary work, has been justified. In the place of a number of poorly provided laboratories, we have a bureau which is well equipped and prepared for its work. The individual scientific worker need not be isolated at some point where intercourse with his fellows is difficult or impossible, but he finds himself in a scientific atmosphere and in contact with students of all branches, giving him a broader and more satisfactory career and bringing to the government better results. In addition to these advantages, a place is provided for visitors of scientific training, where they may learn what has been going on, and may, if they desire, carry on investigations of their own.

The serial publications of the bureau, so far, comprise twelve numbers with two more in press, and the topics which have been covered demonstrate the value of the work. The list is as follows:

Biological Laboratory. 'Preliminary Report of the Appearance in the Philippine Islands of a Disease Clinically Resembling Glanders,' by R. P. Strong, M.D.

Chemical Laboratory. 'The Preparation of Benzoyl-acetyl Peroxide and its Use as an Intestinal Antiseptic in Cholera and Dysentery' (preliminary notes), by Paul C. Freer, M.D., Ph.D.

Biological Laboratory. 'A Preliminary Report on Trypanosomiasis of Horses in the Philippine Islands,' by W. E. Musgrave, M.D., and Norman E. Williamson.

Serum Laboratory. 'Preliminary Report on the Study of Rinderpest of Cattle and Carabaos in the Philippine Islands,' by James W. Jobling, M.D.

Biological Laboratory. 'Trypanosoma and Trypanosomiasis, with special reference to Surra in the Philippine Islands,' by W. E. Musgrave, M.D., and Moses T. Clegg.

I. 'New or Noteworthy Plants.' II. 'The American Element in the Philippine Flora,' by Elmer D. Merrill, botanist.

Chemical Laboratory. 'The Gutta-percha and Rubber of the Philippine Islands,' by Penoyer L. Sherman, Jr., Ph.D.

'A Dictionary of the Plant Names of the Philippine Islands,' by Elmer D. Merrill, botanist.

Biological Laboratory. 'A Report on Hemorrhagic Septicæmia in Animals in the Philippine Islands,' by Paul G. Woolley, M.D., and J. W. Jobling, M.D.

Biological Laboratory. 'A Report on Two Cases of a Peculiar Form of Hand Infection, due to an Organism resembling the Koch-Weeks Bacillus,' by John R. McDill, M.D., and Wm. B. Wherry, M.D.

Biological Laboratory. 'Preliminary Bulletin on Insects of the Cacao,' by Charles S. Banks, entomologist.

Biological Laboratory. 'Report on Some Pulmonary Lesions produced by the Bacillus of Hemorrhagic Septicæmia of Carabaos,' by Paul G. Woolley, M.D.

Biological Laboratory. 'A Fatal Infection by a hitherto undescribed Chromogenic Bacteria-Bacillus Aureus fœtidus,' by Dr. Maximilian Herzog.

I. Serum Laboratory: 'Texas Fever in the Philippine Islands and the Far East,' by J. B. Jobling, M.D., and Paul G. Woolley, M.D.

II. Biological Laboratory: 'On the Australian Cattle Tick—*Boophilis Australis*,' by Chas. S. Banks.

PAUL C. FREER.
BUREAU OF GOVERNMENT LABORATORIES OF THE PHILIPPINE ISLANDS.

SCIENTIFIC BOOKS.

The Nature of Man; Studies in Optimistic Philosophy. By ELIE METCHNIKOFF. English translation, edited by P. CHALMERS MITCHELL. 1 vol. in 8°, pp. xvi + 302, with author's portrait and twenty illustrations. New York and London, G. P. Putnam's Sons. 1903.

In 'The Nature of Man,' Elie Metchnikoff, a Russian professor at the Pasteur Institute, in Paris, presents a valuable contribution to scientific philosophy.

The book is addressed to 'disciplined minds, and especially to biologists.' It is not, the author states in the preface, so much a finished study as food for further thought and investigation, a program of work. But it reaches beyond this. It deals principally with the numerous imperfections and disharmonies in the human constitution and functions, with old age, with the vital instincts and with death.

Man is a comparatively recent and possibly accidental descendant of some anthropoid ape and has differentiated from his ancestors principally through his brain. There are many parts of his constitution that have not kept the same pace in evolution; as a result, man's organism is not throughout harmonious and equally adapted to his present circumstances, which affects adversely his health, happiness and duration of life.

Man is still covered with hairs, though they are no longer needed or capable of protecting his body from cold, and their follicles offer easy lodgment to microbes, which give rise to acne, or even worse forms of skin affection.

The wisdom teeth furnish an instance of disharmony. They are not only nearly useless, but often become a source of trouble that in exceptional cases leads to disease or even death.

The vermiform appendage is another organic disharmony, serving no useful purpose, but often the source of great disorder and danger to life.

Degenerating organs in the human body, such as the cæcum, exhibit disharmony. In fact, the whole of our large intestine is largely superfluous. It is of secondary importance to

digestion and absorption. The loss of a large part of it could easily be endured by man. On the other hand, it is a source, through autointoxication, and diseases peculiar to it, of much danger to man's health and life.

There are disharmonies in our organs of sense, and, particularly, in the organs and functions of reproduction; and there are disharmonies in our instincts as well.

Senility should be a natural, physiological phase of man's existence, but as it exists, it is to a large extent a pathological condition. The fundamental organic change in senility is the atrophy of the higher and specific cells of our tissues and their replacement by hypertrophied connective tissue. A very important destructive rôle in the process is played by the cells known as macrophags. The degeneration of the higher cellular elements and facilitation of the work of the macrophags is aided by all agencies that weaken the organism. Among such stand foremost the poison of syphilis, alcohol and the products of intestinal fermentations.

As to death, we are so accustomed to look upon it as something natural and inevitable, that it has long since come to be regarded as inherent in organisms. This has been disproved by biology. Low, particularly unicellular, organisms, are not subject to the natural death that comes inevitably to man and higher animals. There are even somewhat higher organisms, such as many polyps and some worms, to which natural death does not come; these animals divide indefinitely into new individuals. Hence, death is not necessarily inherent in living organisms. Even our own bodies contain elements practically immortal, the spermatozoa and ova. Natural death in man is probably a possibility rather than an actual occurrence. Old age, as it exists, is not a true physiological process, but exhibits many morbid characters. That being the case, it is not surprising that it seldom ends in natural death.

Would the appearance of natural death in man be accompanied by the disappearance of the instinct of self-preservation and the appearance of another instinct—that of death? To this the author has no exact answer; yet he adduces some testimony favoring that view. It is well known that the instincts of hunger, thirst, movement, etc., allied to those of desire of life and fear of death, often change with age. The instinct of death seems to lie, in some potential form, deep in man's nature. If human life followed its ideal course, fulfilling all its physiological functions, then the instinct of death would appear in its time, after a normal life and an old age healthy and prolonged. As it is, old men die in morbid old age and in the fear of death, without having known the instinct of death, and this constitutes the greatest disharmony of human nature. The goal of existence is the accomplishment of a complete and physiological cycle, in which occurs a normal old age, ending in the loss of the instinct of life and the appearance of the instinct of death. The normal end, coming after the appearance of the instinct of death, may truly be regarded as the ultimate goal of human existence. But before attaining it a normal life must be lived: a life filled all through with the feeling that comes from proper accomplishment of function.

What is to be done? Before all things, it is necessary to try to amend the evolution of human life; that is to say, to transform its disharmonies into harmonies. This can be undertaken only by science, and to science the opportunity of accomplishing it must be given. We must know the human constitution thoroughly, must understand the most intimate details of its mechanism. In the problem of his own fate, man must not be content with the gifts of nature; he must direct them by his own efforts. Just as he has been able to modify the nature of animals and plants, man must attempt to modify his own constitution, so as to readjust its disharmonies.

As will be plain from this brief reference, Metchnikoff's 'Nature of Man,' notwithstanding its slightly misleading title, is a dissertation on some of the most important phases of man's natural history. It is a work remarkable for its simple language and clear style. It is not, as the author admits, a finished work, but it is a well advanced one.

There are a few points which are open to

argument, especially that of the significance among mammals of the large intestine.*

But on the whole the work bears the stamp of a production of an erudite scientist and a deep thinker.

ALEŠ HRDLICKA.
U. S. NATIONAL MUSEUM.

Die Chemie der Zuckerarten. Von Professor Dr. EDMUND O. VON LIPPMANN, Director der Zuckerraffinerie Halle zu Halle a. S. Dritte völlig umgearbeitete Auflage. 1904. Braunschweig, Friedr. Vieweg und Sohn. Gr: 8vo. Pp. xl + 2003. In two volumes. Price, M. 30; bound, M. 34.

This work, the third edition of the prize essay 'Die Zuckerarten und ihre Derivate,' which first appeared in 1878, embodies the sum total of our present-day knowledge of the sugars.

So great has been the progress made and the wealth of material accumulated in this field of research within the past decade that the contents of this work fill fully two thousand pages; for the sake of convenience the publication is issued in two volumes.

The first of these volumes contains the introductory remarks, a copious table of contents and a full discussion of the monosaccharides. The second treats of the di-, tri- and tetrasaccharides, the constitution, configuration and synthesis of the sugars, the relations between the optical, caloric and other physical constants, the origin of the sugars in plants, and of the physiological importance of the sugars. In addition to this there are the addenda, bringing the discussion of the subject matters up to the close of February, 1904; an author's and a subject index—the latter alone covering about fifty pages.

When one recalls the various domains of knowledge with which the chemistry of sugar is necessarily in touch and contact, for instance general, organic, analytic, physical, physiological, medical, pathological chemistry, the chemistry of foods, of fermentation, bacteriology, agricultural chemistry, physics, etc., a faint conception may be formed of the gigantic task which confronted the author in his endeavor to deal adequately with his subject.

Of course, certain limits had to be set, the lines of demarcation had to be drawn somewhere, and of this no one could have been more clearly conscious than the author. With a modesty as charming as it is rare, he states in his preface: 'Completeness could not be attained in any direction,' and yet this work is the most thorough of all works ever published on the chemistry of the sugars.

The fundamental idea governing its whole scope and plan is the giving of a detailed description of the various kinds of sugars and their more immediate derivatives, while less closely allied bodies receive attention only to an extent necessary to define and establish their characteristics.

Instead of entering into a detailed account of the well-nigh innumerable methods of analysis and technology, the author has sought to give their essence and spirit, to sketch in clear outlines their underlying principles. Data relating to the construction and manipulation of polariscopes, to the specific gravity of sugar solutions, etc., data which can readily be found in manuals and text-books, have been omitted.

Scheibler's naming of the sugars has been retained, the author deeming the time not yet come for the adoption of Emil Fischer's rational system of nomenclature. A noteworthy feature of the book is the manner in which the table of contents and the index complement each other, the former referring to the general topics, while the index lists the individual chemical terms and expressions.

Space, of course, forbids here entering upon a detailed review of these volumes; all that may be done is to sum up in a few words the impression left by a careful, critical examination of their pages. The style in which the book is written is attractive—concise, clear, forceful. There is no question but that von Lippmann in his 'Chemie der Zuckerarten' has given to chemical science a monograph

* Metchnikoff considers that, in the active mammalian life, 'the need to stop in order to empty the intestines would be a serious disadvantage' and implies that this factor may have had influence in the evolution of the organ.

which in thoroughness, lucidity, in masterly treatment throughout, is rivaled by but few, excelled by none. F. G. WIECHMANN.

SCIENTIFIC JOURNALS AND ARTICLES.

THE *Botanical Gazette* for June contains the following articles: Dr. Roland Thaxter publishes a further contribution on the Myxobacteriaceæ, especially in reference to the work of Migula, Zukal, Miss A. L. Smith and Zederbauer; also establishing eight new species. John Donnell Smith contributes his twenty-sixth fascicle of 'Undescribed Plants from Guatemala and Other Central American States,' describing twelve new species. Thomas H. Kearney asks the question, 'Are Plants of Sea Beaches and Dunes True Halophytes?' reaching the conclusion that these are not generally halophytic. Alice Eastwood publishes fourteen new species of western Polemoniaceæ. George J. Peirce, in 'Notes on the Monterey Pine,' shows that the difference in the quantities of water and solutes drawn up through the xylem into galled and normal leaves furnishes the reason for the differences in the amount of conducting tissue as shown by the annual rings. In other words, amputated seedlings and branches bearing galled leaves develop bundles which vary from the normal according to the degree of injury which the leaves have undergone. This is confirmation of Jost's conclusion that leaves and vascular bundles are closely correlated in their development. Amon B. Plowman publishes the 'Celloidin Method for Hard Tissues' as developed and perfected by Professor E. C. Jeffrey. M. A. Chrysler publishes 'Anatomical Notes on Certain Strand Plants,' being the results of a comparative study of the leaf anatomy of certain plants in the vicinity of Woods Hole and near Lake Michigan. Charles E. Allen makes a preliminary announcement of his conclusions in reference to chromosome reduction in *Lilium canadense*, being quite different in some points from those previously maintained.

THE June issue of the *Bulletin of the Michigan Ornithological Club* contains the following articles: 'Some Notes on the Life History of the American Redstart,' by J. Claire Wood, with a full-page cut of the species by Louis Agassiz Fuertes. Bradshaw H. Swales concludes his 'List of the Land Birds of Southeastern Michigan.' A. H. Griffith contributes 'Birds in Decoration,' which is illustrated by specimens of Japanese art from the Detroit Museum of Art. P. A. Taverner writes on the 'Tagging of Birds' as a means of solving some of the vexing problems of migration. Walter B. Barrows describes the ornithological and oological collections of the Michigan Agricultural College, which is supplemented by a half-tone of the interior. Alexander W. Blain, Jr. notes the capture of 'Three Rare Michigan Birds.' There are other notes of value and the usual reviews. With this issue Professor Barrows becomes one of the editorial staff.

SOCIETIES AND ACADEMIES.

THE RESEARCH CLUB OF THE UNIVERSITY OF MICHIGAN.

AT the meeting of the club held April 27 Dr. Novy presented the results obtained in collaboration with Mr. McNeal on the cultivation of the organisms causing trypanosomatic diseases. These investigators have been able to cultivate three of these protozoa. The organism *Trypanosoma lewisi* has now been under cultivation for two years. *T. brucei*, the cause of nagana or the tsetse-fly disease of South Africa, has been under cultivation since last August. The culture medium sent from Manila, after inoculation with the trypanosome from a cow suffering with surra, on arrival in Ann Arbor, showed an excellent culture of this organism which had developed en route. This organism was kept alive for sixty-five days, but all efforts to secure infection in animals or to obtain subcultures failed.

A comparison of the trypanosome from the Philippine surra with that from the Island of Mauritius seems to indicate that the two are entirely distinct.

The cultural characteristics of the Philippine trypanosome are such as to distinguish

it readily from *T. brucei,* the cause of the South African tsetse-fly disease. This confirms the work of Laveran and Mesnil on the non-identity of these two diseases and effectually disproves the view held by some that the various trypanosomatic diseases are due to one and the same organism.

The culture of *T. brucei* is nearly but not quite as virulent as the material from an affected animal. Such virulent cultures, developed at room temperature or at 25° C., when placed at 34° C. for two days lose their pathogenic properties; and by means of such attenuated cultures it is possible to immunize a guinea-pig. This fact is of importance, since it may have a bearing upon the prevention of these diseases.

It was further shown that cultures of *T. lewisi* at times contain very minute forms of the organism and that when such material is passed through a Berkefeld filter the resultant filtrate on inoculation into rats produces a typical infection. This goes to show that even a large protozoon may have a sufficiently small form, even if it is not ultra-microscopic, which can traverse the pores of a filter.

Dr. Novy was followed by Professor Lloyd, who read a paper on 'The History of Ethics.'

The last meeting of the year was addressed by Dr. J. E. Duerden, who gave an account of his researches on the morphology and development of recent and fossil corals, and by Dr. Geo. A. Hulett, who read a paper detailing the results of his work on standard cells.

The latter paper showed that the hydrolysis of mercurous sulfate (Hg_2SO_4), the depolarizer, has been worked out, and the effects of the hydrolytic products of the electromotive force of the cadmium cell determined. The author's method of preparing electrolytic mercurous sulfate was described, as well as methods of preventing hydrolysis in the setting up of the standard cells. The results indicate that the cells are reproducible with a variation of but a few parts in 100,000. The details will soon be published in an article on 'Mercurous Sulfate in its Relation to the Standard Cells.'

FREDERICK C. NEWCOMBE,
Secretary.

THE TORREY BOTANICAL CLUB.

THE club met April 27, 1904.

The first paper of the scientific program was by Dr. N. L. Britton, on 'Explorations in Florida and the Bahamas.' This was illustrated by maps and specimens, and described the general features of the flora of the region of the part of subtropical Florida south of Miami, to which a visit of three weeks' duration was made in March and early April with Mrs. Britton and Dr. M. A. Howe, in cooperation with Professor P. H. Rolfs, of the U. S. Subtropical Laboratory. A detailed account of the flora was not taken up, inasmuch as Dr. John K. Small, who explored the same region last autumn, and who will again visit it in May, proposes to publish a complete account of the material secured. Two genera, new to the continent, both represented in Florida by a single species, were discovered, *Alvaradoa* in hammock lands and *Sachsia* in pine lands, both of these genera existing also in Cuba and in the Bahamas.

Dr. C. F. Millspaugh, of the Field Columbian Museum, joined the party early in April, and the Island of New Providence in the Bahamas was partially explored. The distribution of plants of this island was described, the littoral zone containing many common West Indian and Floridan species, of which the most characteristic are, perhaps, the shrubs *Jacquinia Keyensis* and *Salmea petrobioides* the latter endemic in the Bahamas.

Between the littoral zone and the interior regions of the island there is in places a plant society, which may be termed an intermediate one, characterized by such shrubs as *Buxus Bahamensis, Banara reticulata, Calliandra formosa.*

The pine lands (*Pinus Bahamensis*) contain among other species, *Pteridium caudatum, Vernonia Bahamensis* and *Byrsonima lucida,* as characteristic species. The palmetto lands (apparently *Inodes Palmetto*) contain more herbaceous vegetation than the other regions including *Linum Bahamensis, Sachsia Bahamensis* and *Sabbatia campanulata,* though also having a considerable number of shrubs. The 'coppets' or 'hammocks,' as they are called in Florida, are areas devoid of either pines or

palmettos and often occupy isolated areas entirely surrounded by pine forests as in southern Florida; characteristic trees of these hammocks are *Dipholis salicifolia, Eugenia confusa, Icacorea paniculata* and *Cocolobis laurifolia,* all of which occur in similar situations in Florida.

Dr. C. F. Millspaugh, who was with Dr. Britton and remained somewhat longer, was asked to discuss the paper. He reported that plants found in bloom at the center of the island were found in fruit at the west end, while at the east end, which is dry and rocky, the buds of the same species were scarcely started. South Bemini is much like New Providence in vegetation, though its elevation is less. A *Rhus* resembling *R. toxicodendron* was found on Cat Cay and there is an interesting palm on the same island.

Inquiry was made concerning *Croton Eluteria,* which is prized in West Indian countries as a bitter drug, but is said to be disappearing. The plant had not been seen, but a guide said that it grew on South Bemini.

Professor Underwood called attention to *Odontosoria clavata,* which in Jamaica and Cuba grows in very wet places and is a soft tender plant, while in the Bahamas what is apparently the same species grows in dry pot-holes and is firmer and stronger.

The second paper was by Dr. D. T. MacDougal on 'Desert and Delta Vegetation of Sonora and Baja, California.' The Colorado River has been called the Nile of America. It flows 600 miles without tributaries and has a delta 150 to 200 miles long by 50 to 100 miles broad. In this region is the most pronounced desert in the United States and probably in America. The topography of the region may be described as a great basin with the Colorado River flowing along the eastern margin. The Salton basin is 400 feet below sea level and in times of unusual flood is transformed into a great lake by overflow of the Colorado River, the last such flood occurring in 1891, when part of the track of the Southern Pacific Railroad was under water. At one point in this basin there has been an elevation of mud volcanoes from ten to fifty feet high, where there are hot sulphur springs. The dry season is from August to April or May. At the end of the wet season the Indians dig holes deep enough to get into and plant their corn and melons in these. The surface of the ground becomes very dry, but enough moisture is retained to mature the crops. Within a few yards of the river channels relative humidities of eleven, twelve or thirteen per cent. were observed. The temperature of the summer flood water is 45° to 55°, while the air temperatures are the highest to be found in the country, 100° to 125°. At the lower end of the delta is a region of brackish water.

Distichlis spicata is widely distributed on the mud flats; the Mexican poplar, an unidentified willow and the mesquite were the trees observed, while the arrow-weed forms almost impenetrable thickets. Within the width of a few yards one passes from river vegetation to true desert.

Ammobroma Sonoræ, described by Torrey, has a stem two to four feet long, all buried except the head. It is parasitic on *Atriplex* roots. A puff ball with the same form and similar appearance was found, but it was too brittle to stand carrying.

The east coast of Baja, California, near the head of the Gulf, is supposed to be the driest spot in America. One half inch of rain only has been recorded at Yuma during 1903, and Palmer visited an island in the gulf in 1889 which had no rain for a year and a half. Landings were made at three points, the farthest at San Felipe Bay, 55 miles below the river. Mr. Brandegee visited San Luis Bay once, but the San Felipe region was entirely unexplored by botanists. Here the coast rises by gradual slope to 500 feet and then by precipitous rocks to peaks, one of which is over 10,000 feet high. The seasons are evidently irregular and not clearly marked. Many of the plants have milky or resinous juice and many are aromatic. *Cereus Schottii* was found forming dense groves near San Felipe. Living plants of what is probably *Cereus Pecten-aboriginum* were brought home. The Indian-comb cactus has a short trunk and long branches in contrast to the usual form of *C. giganteus.*

Although the plants are very sparse it is not

to be supposed that they have a harder struggle for existence than others, as is shown by trying to grow them under artificial conditions. *Fouquieria splendens* seems to reach its optimum development in the delta lands. Cactuses with sheathing spines were noted and some of these shed their spines. The flora is not Arizonian. In San Felipe there are no plants with storage organs, for there is no surplus of water to store.

In the discussion it was mentioned that the poison cacti are all unarmed.

Professor Underwood remarked on a specimen of the southern brake sent from Burlington, Vt. This form described in recent years as *Pteris aquilina* var. *pseudocaudata* by Clute, is the *Pteris latiuscula* Desv., described in 1827.

WILLIAM T. HORNE,
Secretary pro tem.

SCIENCE CLUB, UNIVERSITY OF MISSISSIPPI.

THE last regular meeting of the club for the year 1903–4 was held May 20 in the chemical lecture room.

Mr. H. R. Fulton read a paper the purpose of which was to give some account of the life histories and habits of the common mosquitoes. It was stated that of the thirty species of mosquitoes occurring in North America, ten have been found in Mississippi. Attention was directed particularly to three genera: *Culex, Stegomyia* and *Anopheles.* The first was said to be the most numerous and widely distributed, not, however, transmitting disease, so far as known, and important chiefly because of the annoyance which it occasions. The second, found in many of the southern states and flourishing in the tropics, was charged with being certainly instrumental in the transmission of yellow fever. The last, also widely distributed, was said to convey malaria.

The four distinct stages—egg, larva, pupa, adult—in the complete metamorphosis through which every mosquito passes in its development were fully treated, as, also, the peculiarities of size, shape, markings, movements, etc., which differentiate the three genera.

Length of flight, local breeding places and the methods used by the author of the paper in attempting to check and exterminate mosquitoes in this vicinity were discussed.

In speaking of the movements of the larva of *Culex,* Mr. Fulton stated that he had observed a movement of which he had found no mention, this being in a horizontal plane, taking place as the larva moves under the surface or over the bottom or through the intermediate water, unaccompanied by violent body-movements, and probably caused by rapid vibrations of the numerous hair-like processes covering the body.

Dr. J. B. Bullitt added some remarks on those mosquitoes which transmit malaria and yellow fever.

ALFRED HUME,
Secretary.

DISCUSSION AND CORRESPONDENCE.

A CASE OF PLAGIARISM.

TO THE EDITOR OF SCIENCE: In a note on 'The Mechanism of the Mont Pelée Spine' (SCIENCE, June 17, 1904), I say: 'So far as the literature has come to my attention, it has failed to include a factor which appears to me of prime importance,' etc. Through this sentence I claim originality, and presumptive novelty, for an idea which I now know not to have been novel, and think not to have been original. The idea was published six months earlier by Dr. A. C. Lane in a note on 'Absorbed Gases and Vulcanism' (SCIENCE, December 11, 1903). It is not necessary, in dealing with my friend Dr. Lane, that I disclaim intentional plagiarism, but, as I find interest in the mental process of my blunder, I venture to relate what I suppose to be its history. It is altogether probable that I read Dr. Lane's note when it appeared, but the mental impression it made was so faint that in re-reading it now I can not definitely remember seeing it before. Nearly a half year later an idea as to the Pelée spine occurred to me and I wrote it out for publication. While I supposed the idea original, there was in my mind a faint suspicion that the suggestion might have come from some outside source, and this suspicion led me to search all the literature of the spine that I could recall having seen—but I did not recall that Dr. Lane had made a contribution. Thus a

mental impression too faint for complete identification, now that attention is directed to it, nevertheless rose into consciousness with the semblance of a spontaneous idea, and gave rise to a distinctly plagiaristic publication.

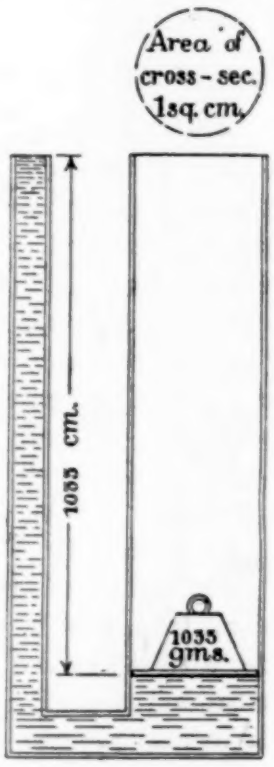
G. K. Gilbert.

San Francisco,
June 28, 1904.

SPECIAL ARTICLES.

THE ASCENT OF WATER IN TREES.

Recent discoveries by Vesque and E. B. Copeland and others have brought us very near the solution of this inveterate problem; but botanists seem agreed to halt at the last



Hydrostatic Paradox.

step, awaiting some occult signal from the physicists. The old toy of the 'hydrostatic paradox' ought to teach them that water pressed upwards by the atmosphere has no divine right to call a halt at 1,033 centimeters. One fluid may support and also elevate another fluid to any required height. Thus the supported weight in the annexed diagram may be represented by a column of water raised a mile high or more. The condition is that there shall be no immediate continuity of mass between the fluid to which the atmospheric pressure is applied, and that which is to be lifted. This condition is secured in the tree by the numerous transverse septa on its water-ducts, which prevent the transmission of air or water in mass, but permit a very free molecular diffusion of water, and of everything dissolved in it.

Assuming the diameter of a water-duct to be half a millimeter, it is easy to estimate the weight supportable by a septum at its base; seeing that its upward parts are protected from other atmospheric pressure. The area of the cross-section of the basal part, in centimeters, if multiplied by 1,033 (the height in centimeters of a column of water equaling the atmospheric pressure), gives 2.028 cubic centimeters, or the same number of grams, as the load which the basal septum can support. This load may be a column of water filling the whole duct for a height of 34 feet, or it might be a column or stream of water twelve times as high and only one twelfth as large in cross-section. If the duct were filled with one part of water and eleven parts of air, the water and air together should be supported by the atmospheric pressure at the base to a height of about 403 feet. Assuming that there were in this course about 90 cross-septa, approximately equidistant, we should have a fall of pressure with each succeeding stage, equivalent to about one third of an inch of the mercurial barometer, reaching zero at the summit.

The mechanism in the xylem-ducts, however, can not be of this kind; because not only would the gas-bubbles obstruct the current if they came between it and the walls, but the spreading out of the pressure of the ascending current over the septa would cause the 'hydrostatic paradox' to work backwards with greatly increased force. This compels us to favor the view of interning the gas-bubbles within the water. Dr. MacDougal states that 'the cavity of a wood-cell contains a bubble of gas' ('Plant-Physiology,' p. 29). And Strasburger describes the water as freely streaming round the gas bubbles, or between them and the walls. This arrangement of water surrounding gas-bubbles constitutes what is

known as foam; not, indeed, of the rough kind, but 'dressed' so as to be in unison with the shape of the duct through which it must pass. It would take a great many hundreds of meters of such foam to weigh a kilogram to the square centimeter. Thus the atmospheric pressure at the base proves to be sufficient for the work to be done. Every change of equilibrium will cause a movement upwards of the water which is the only movable ingredient of the mixture.

If we are correct in accepting the observations that the water thus surrounds and encloses the continuous or beaded air-globules (which must also have much vapor of water) not only is the streaming of the water accounted for, but also such phenomena as capillarity and diffusion, and occasional stasis reminding one of the phenomena of capillary circulation of blood. Also the correlation which Strasburger, Vesque and others have observed between the state of the barometer and the streaming within the xylem-ducts is explained; and possibly the pulsation of gas-bubbles which MacDougal regarded as helping to raise the water upwards.

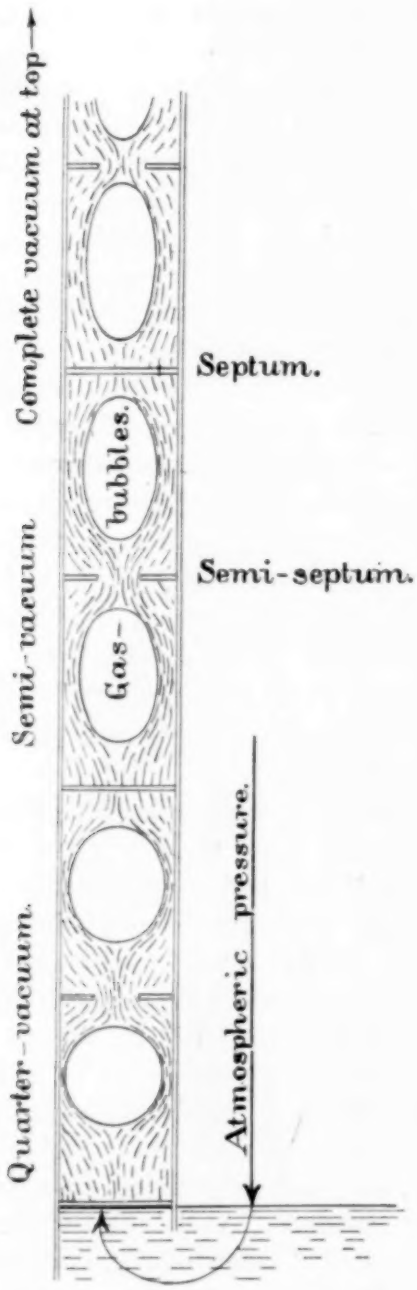
The condition of low apical pressure is secured by the activity of the leaves correlated with the structure of the ducts. The leaves are not known to actively attract the water, but they always remove it as it arrives, turning it into starch, and transpiring it in great quantity. When they die or are stripped, the ascent of water ceases (though at lower parts of the stem bleeding may be thereby induced). Also in the leaves and downwards the water-ducts are protected from direct atmospheric pressure by their structure, having spiral threads, and bars and thick walls to prevent compression, and having their very tips roofed over by domes. Their pits with thin membranes permit diffusion sideways, into other ducts or into parenchyma; and thus interchange is secured among the different elements. The machine will not work if the walls are torn, but if they are whole, their being dead does not obstruct their action. The fact that trees become stag-headed from a loss of water proves a delicate adjustment, especially as the different species have their differences of height and other idiosyncrasies relatively to the phenomenon.

The transverse septa of the water-ducts appear to us to play a leading part in the process. Transmitting the water by diffusion and intercepting the gases, they constitute a series of chambers each having a number of immobile air-bubbles, and permitting the water to flow between these by the only channel which it can take. We do not know how thick is the stream, otherwise than by the deductive method given above, but it probably varies in thickness and rapidity relatively to the height and leafage of the tree; very lofty trees having little leafage, and yet having many water-ducts. We think that the dynamical part of the problem is explainable mainly by the *vis a tergo* of the atmospheric pressure at the base.

The tracheids of the giant conifers exhibit the same principle, by their bordered pits with a torus which is centrally thickened and is overarched by diaphragms. The torus is a relatively large flexible membrane, which transmits the whole pressure, and at the same time limits the quantum of water that can find a passage upwards.

The air drops are not only obstructed by the septa, but they seem to keep apart within a section, as if we had a combination of the Jamin-theory with the osmotic functions of the septa. Each air-drop seems to have a shell which prevents its fusing with its neighbors, and thus the system becomes a sort of emulsion, like the fat-globules in milk. My colleague, Professor E. H. Loomis, who has aided me by criticizing the physical points, furnishes me with a striking illustration of this phenomenon. A bubble of air having got into one of his barometers, and being imprisoned between the mercury and the glass, he let in other bubbles. But these carefully avoided it; and when their course seemed to indicate collision and fusion, they turned aside and passed round it, escaping contact. Another colleague tells me of a case in Kansas where the lives of a community were saved during a drouth by a rotten pump which admitted air as well as water and raised the mixture about 40 feet after the other pumps had given out.

The second diagram represents the air-bubbles as gradually narrowing upwards. This accords with the theorem of Schwendener and Steinbrink, who held that the ducts are exceedingly narrow at their tips. The same result is given from observations on the red beech by Hartig and Weber. Strasburger had previously shown that narrow ducts contain very little air, and have streaming water; whilst large ducts in tall stems have much air and usually little water. If we accept these data we find an extraordinary correlation. Through the length of a lofty stem are wide tubes, whose contents are a column of froth of the lightest kind, having a maximum of air in a very thin shell of water. In the region of the leafy spray the conditions are reversed, narrow ducts and a relatively heavy load; and hence the need of a high vacuum, which is secured by the curious structure and the proximity of the leaves.



Xylem-duct.
(diagrammatic)

I am obliged to Professor MacDougal for referring me to Steinbrink's paper, and to Mr. Earle Anderson for drawing the diagrams.

George Macloskie.
Princeton University,
June 25, 1904.

BOTANICAL NOTES.

THE NUMBER AND WEIGHT OF COTTONWOOD SEEDS.

At my suggestion, one of my students, Mr. B. R. H. d'Allemand, made careful counts and estimates as to the number and weight of the seeds of the cottonwood (*Populus deltoides*). Selecting a well-grown pistillate tree about forty feet in height with a trunk two feet in diameter, and a spreading top fully forty-five feet from side to side, he carefully divided it by an imaginary vertical plane into two equal parts. One of these halves he divided again in the same manner, and continued the process until he reached a branch small enough to enable him to count the number of catkins which it bore. It was found in this way that the tree bore about 32,400 catkins. Then a number of careful counts were made of the seed pods in the catkins, by which it was found that the average number is about twenty-seven. The average number of seeds in the pods was easily determined by a series of counts to be thirty-two. From this it appears that this particular tree produced the enormous number of nearly twenty-eight millions of seeds.

One hundred seeds with their cottony fibers attached were then weighed upon a chemical balance. The result was .065 gram. So the weight of a single seed is .00065 gram, and the total weight of all the seeds on the tree 18.2 kilograms, or almost exactly forty pounds.

WEIGHT OF DANDELION-DOWN.

How heavy is a dandelion-down with its achene as it floats away on the breeze? The tiny parachute is so constructed that the weight of the achene brings the spreading rays at the summit of the slender rod (*rostrum*) into the proper position for floating in the air, as any one may readily see for himself by 'blowing' a seeding dandelion head in a quiet place. It makes no difference what the position of the parachute may be, as soon as it is free in the air the weight of the achene rights it at once. One who has not closely observed dandelions will be much interested in watching the quick 'righting' of every little parachute under the action of the tiny achene weight. Recently it occurred to me to find out how heavy dandelion-downs are, and at my suggestion Mr. d'Allemand undertook the delicate task of weighing them. He found that there are about one hundred and ninety achenes in each dandelion head, and, carefully counting this number, he determined their aggregate weight to be .085 gram. From this it was easy to calculate the weight of a single achene to be .00044 gram. It takes more than two and a quarter millions of dandelion-downs to weigh a kilogram, and somewhat more than one million to weigh a pound. In other words each parachute weighs about one millionth of a pound!

TENDRILS OF VIRGINIA CREEPER.

IT is pretty generally known nowadays that some Virginia creepers cling to walls by discoid expansions of their tendril tips, while others produce twining tendrils without such expansions. Among gardeners there is a pretty general notion that there are two quite distinct kinds, distinguished mainly by the presence or absence of disks. This distinction has even been admitted into recent descriptive manuals, as in Britton's 'Manual,' where the disk bearing form is called *Parthenocissus quinquefolia,* and a form with 'tendrils mostly without terminal adhering disks' is set off as the variety *laciniata.*

In a recent popular article Professor Pammel gives his opinion that this difference as to the formation of disks is not constant with any particular plant, and in a subsequent letter cites the case of the planting of a disk-bearing Virginia creeper which later formed ordinary twining tendrils only. On smooth surfaces the disks are not produced. This agrees with the statement made by Goebel in his 'Organography of Plants' (page 268, English edition) as follows: "Mohl was the first to show that the adhesive disks on the tendrils of certain species of *Ampelopsis* appear in consequence of contact with a firm body. We have here to do with a contact stimulus. Different species of *Ampelopsis* behave differently. Some, like *A. hederacea,* possess ordinary tendrils which twine round a support and eventually become firm, woody structures, but if they do not happen to find a support they die off at an early period. *Ampelopsis quinquefolia,* on the other hand, fixes itself to walls and tree trunks by means of adhesive disks on its tendrils, but these can also act like ordinary tendrils. In tendrils which do not come in contact with a firm body no viscid disks appear." Making allowance for some confusion as to the identity of the species, it appears that Goebel regards the formation of disks as a result of a mechanical stimulus. There is need of a number of careful observations on this point in connection with one of the most widely grown of all ornamental climbing plants.

CHARLES E. BESSEY.
THE UNIVERSITY OF NEBRASKA.

FIELD WORK FOR 1904 OF THE DIVISION OF GEOLOGY AND PALEONTOLOGY OF THE UNITED STATES GEOLOGICAL SURVEY.

THE field work of the division of geology and paleontology, United States Geological Survey, for the season of 1904 will cover investigations in many states. Dr. C. Willard Hayes, geologist in charge of geology, has general supervision of this work. Some of the most important of the numerous parties in the field are here mentioned.

General Investigations.—Besides investigations confined to the limits of one or two states, several lines of work will be taken up that will cover wide general areas. The gla-

cial geology of the United States will be studied by Professor T. C. Chamberlin, who will have the assistance of Messrs. R. D. Salisbury, W. W. Atwood, F. H. H. Calhoun, Frank Leverett, W. C. Alden and F. W. Taylor. The glacial areas in the Rocky Mountain region will be carefully investigated by Professor Salisbury, assisted by Messrs. Atwood and Calhoun. A monograph on the Pleistocene formations of the lower peninsula of Michigan and adjacent portions of Indiana will be completed by Mr. Leverett. Mr. Alden will map portions of southeastern Wisconsin for folio publication.

The pre-Cambrian and metamorphic geology of the United States will be studied under the direction of Professor C. R. Van Hise, who will also complete his report on the geology of the Lake Superior region. In this work he will be assisted by Messrs. C. K. Leith and W. N. Smith. He is also directed to continue investigation of the metamorphic iron-ore deposits of the United States, particularly those of the Rocky Mountain and Great Basin region.

Other general investigations covering several states will be conducted by Mr. E. C. Eckel. He will complete a study of the cement industry of the United States and prepare a report in which special attention will be paid to the geologic and economic relations of the industry. Mr. Eckel will also complete an investigation of the slate industry of the United States, directing the work of Professor A. H. Purdue in Arkansas and Professor T. N. Dale in Virginia, West Virginia, Maryland, Pennsylvania, Maine and Vermont.

The Mississippi Valley.—Several states will be included in an investigation to be made by Mr. H. Foster Bain of the lead and zinc deposits of the Mississippi Valley. He will make a special study of their genesis, geologic occurrence and economic importance. His specific task is to examine the lead and zinc deposits of the upper Mississippi district in Illinois, Iowa and Wisconsin and to prepare a preliminary report upon this district. In addition he will examine certain copper deposits in Shannon County, Missouri, associated lead and zinc ores in St. Genevieve County and in the Mine Lamotte district, and the St. Clair and Granby mines in southwestern Missouri. He is also directed to reexamine the more important lead and zinc mines of the western Kentucky district and to make a reconnaissance examination of the lead and zinc district of the Appalachian Valley in Virginia and Tennessee. Mr. E. O. Ulrich, who is directed to investigate the Silurian and Ordovician paleontology and stratigraphy of the northern Mississippi valley, will cooperate with Mr. Bain in the study of the lead and zinc deposits of that district.

Alabama.—An areal and economic survey of the Brookwood quadrangle, Alabama, will be made by Mr. Charles Butts, who will be assisted by Mr. Hoyt S. Gale. They will probably also begin work upon the Jasper quadrangle, Alabama.

Arkansas.—Professor A. H. Purdue will make an areal and economic survey of the Winslow quadrangle, Arkansas. If time permits, he will also make an economic investigation of the developed slate deposits of Arkansas.

California.—The areal geology of the Redding quadrangle, California, will be revised by Mr. J. S. Diller. He will also complete an areal and economic survey of the Indian Valley Special quadrangle, California.

Mr. Arthur C. Spencer will cooperate with Mr. Waldemar Lindgren in making an investigation of the economic geology of the Redding quadrangle, California.

An areal and economic survey of the Tejon quadrangle, in southern California, will be made by Mr. George H. Eldridge. He will also make, for correlation purposes, the necessary reconnaissance examinations of regions adjacent to this quadrangle.

The areal and economic survey of the Santa Cruz quadrangle, California, will be completed by Dr. J. F. Newsom, who will be assisted by Dr. Ralph Arnold.

Dr. G. K. Gilbert will continue his investigations of the glaciology and physiography of the High Sierras.

Colorado.—Under the direction of Dr. Whitman Cross, detailed areal mapping will be continued in the San Juan region of Colorado.

The Ouray quadrangle will be surveyed and the work extended as far as possible into the adjoining Lake City quadrangle. The survey of the Engineer Mountain quadrangle will also be completed. Dr. Cross will have the assistance of Messrs. Ernest Howe, W. H. Emmons and Albert Johannsen.

Mr. J. E. Spurr will begin an investigation of the areal and economic geology of certain mining districts in Colorado, chiefly in Gilpin and Clear Creek counties. Mr. Spurr will be assisted by Messrs. Sydney H. Ball, George H. Garrey and Oscar H. Hershey.

Mr. S. F. Emmons will complete his monograph on the geology of the Leadville mining district and Dr. J. D. Irving will make an investigation of the ore deposits of the Ouray district.

Delaware.—The Cretaceous and Tertiary formations of Delaware will be investigated by Professor William B. Clark.

Florida.—Mr. George H. Eldridge will complete field work in the phosphate district of Florida and prepare a final report on the region.

Georgia.—A thorough revision of the areal, structural and economic geology of the Cartersville special and Cartersville regular quadrangles, Georgia, will be made by Mr. Laurence LaForge. Preliminary work will be done in the Dahlonega district by Mr. Arthur Keith.

Idaho.—The areal and economic survey of the Cœur d'Alene mining district, Idaho, will be completed by Dr. F. L. Ransome. Special attention will be given to the ore deposits. Such reconnaissance examinations of the adjoining regions as may be deemed necessary will be made. Mr. F. C. Calkins will assist Dr. Ransome in this work.

Indian Territory.—Areal and economic surveys of the Sansbois, McAlester, Tuskahoma and Windingstair quadrangles, Indian Territory, will be made by Mr. J. A. Taff. Mr. E. O. Ulrich will cooperate with him in determining the stratigraphic succession in Indian Territory.

Kansas.—Mr. F. C. Schrader will make an areal and economic survey of the Independence quadrangle, Kansas. He will be assisted by Professor Erasmus Haworth, who will pay special attention to the investigation of the underground structure and its relation to the accumulation of oil and gas.

Louisiana and Texas.—Professor N. M. Fenneman will make an economic investigation of the oil fields of the gulf coastal plain of Texas and Louisiana.

Maine.—Dr. George Otis Smith will, with the assistance of Messrs. E. S. Bastin and C. W. Brown, continue the survey of the Penobscot Bay quadrangle in Maine. Dr. Smith will also exercise general supervision over geologic work in New England and the crystalline belt of New York and New Jersey.

Maryland.—Acting in cooperation with the Maryland State Geological Survey, Professor William B. Clark will continue areal and economic surveys in Maryland for the preparation of geologic folios.

Massachusetts.—Professor B. K. Emerson will continue his investigation of the areal and structural geology of central Massachusetts.

Mississippi.—In cooperation with the division of hydrology, Mr. E. C. Eckel, assisted by Mr. A. F. Crider, will prepare a report on the geology and the water resources of Mississippi.

Missouri.—The Silurian and Ordovician paleontology of central Missouri will be investigated by Mr. E. O. Ulrich, who will work in cooperation with the state survey. The lead and zinc deposits of the state will be examined by Dr. H. F. Bain.

Montana.—Mr. W. H. Weed will complete the preparation of a report on the Butte mining district.

New Jersey.—In cooperation with Messrs. N. H. Darton and W. B. Clark, Dr. Florence Bascom will make an areal survey of the pre-Paleozoic formations of the Trenton quadrangle, New Jersey, in preparation for the Trenton folio. Dr. Bascom will also complete the mapping of the Paleozoic, pre-Paleozoic and Pleistocene formations in the Burlington, Lambertsville, Bordentown and Princeton quadrangles.

Professor W. S. Bayley will complete the mapping of the crystalline rocks of the Raritan quadrangle, New Jersey. He will also

make an areal, economic and structural survey of the crystalline rocks of the Delaware Water Gap, Easton and Allentown quadrangles, in New Jersey and Pennsylvania.

A thorough field revision of the areal and economic geology of the Franklin Furnace quadrangle, New Jersey, will be made by Dr. A. C. Spencer, who will also prepare a report on the economic geology of the district. Dr. Spencer will cooperate with Professor J. E. Wolff in the preparation of the Franklin Furnace folio.

New York.—Professor R. S. Tarr will complete his investigation of the Pleistocene geology of the Watkins Glen quadrangle, New York, and will prepare the Pleistocene section for the Watkins Glen folio. He will also investigate the Pleistocene geology of the Harford-Owego quadrangle, New York, and prepare the Harford-Owego folio in cooperation with Professor H. S. Williams.

Professor Williams, assisted by Dr. E. M. Kindle, will make an areal and economic survey of the quadrangle that embraces the Dryden, Harford, Owego and Appalachian quadrangles, New York.

Professor J. F. Kemp will continue the areal and economic survey of the eastern part of the Adirondack region.

Nevada.—Mr. J. E. Spurr will visit the Tonopah district, Nevada, some time during the summer, in order to make a final revision of his conclusions before publishing the report on the Tonopah ore deposits on which he has been at work for the last year.

North Carolina, South Carolina, Tennessee and Georgia.—Mr. Arthur Keith will complete areal and economic surveys of the Mount Mitchell, Nantahala, Cowee, Pisgah, Roan Mountain and Morganton quadrangles, in North Carolina, South Carolina and Tennessee, with a view to the preparation of geologic folios. Assisted by Mr. Hoyt S. Gale, he will make a reconnaissance of the Hickory, Pickens, Walhalla and Dahlonega quadrangles, North Carolina and Georgia. Dr. W. Lindgren, assisted by Mr. L. C. Graton, will make a preliminary investigation of the mineral resources, particularly gold and tin, in several counties of the northeastern part of South Carolina.

Ohio and West Virginia.—A revision of the Cadiz-Steubenville quadrangles in Ohio and West Virginia will be made by Mr. M. R. Campbell, who will prepare the Cadiz-Steubenville folio in cooperation with Mr. W. T. Griswold.

Pennsylvania.—Mr. M. R. Campbell will revise the mapping of the Slatington quadrangle, Pennsylvania, for the preparation of the Slatington folio. In cooperation with the state of Pennsylvania, he will also survey for folio publication the Amity, Rogersville, Burgettstown and Claysville quadrangles. In this work he will have the assistance of Messrs. W. T. Griswold and F. C. Clapp.

The Trenton limestones of eastern Pennsylvania and their continuation into New Jersey will be mapped by Mr. R. S. Bassler for the purpose of furnishing information to Mr. E. C. Eckel that may be of assistance to him in the preparation of his report on the cement resources of the United States.

In cooperation with Messrs. N. H. Darton and W. B. Clark, Dr. Florence Bascom will complete the field work and prepare for publication the Philadelphia special folio.

Texas.—Mr. E. C. Eckel will visit northeastern Texas, particularly Marion, Cass, Morris, Camp, Harrison and Upshur counties, for the purpose of making a reconnaissance examination of iron-ore deposits and determining the areas in which topographic and geologic work can most advantageously be taken up next year.

Utah.—Mr. J. M. Boutwell will complete an investigation of the mining geology of the Park City district, Utah. He will also make a reconnaissance of the areal, stratigraphic and structural geology of the western portion of the Uinta Mountains. Mr. Lester H. Woolsey will assist him.

Vermont.—Areal and economic surveys will be made in western Vermont by Professor T. Nelson Dale.

West Virginia.—Dr. George H. Ashley, assisted by Mr. W. C. Phalen, will make areal and economic surveys of the Nicolas quadrangle, West Virginia.

Mr. George W. Stose will complete the areal and economic surveys on the Pawpaw and Hancock quadrangles, in West Virginia and Maryland. He will be assisted by Mr. E. F. Burchard.

Wisconsin.—Professor U. S. Grant will make an areal and economic survey of the Mineral Point quadrangle, Wisconsin. The work will probably be done in cooperation with the state survey of Wisconsin.

BARON TOLL.

PRINCE KROPOTKIN contributes to the last number of the *Geographical Journal* an account of the return of the expedition sent to search for Baron Toll, under the direction of Lieutenant Kolchak. There appears to be little hope that Baron Toll and Dr. Seeberg have survived. The last news from them is a letter found in Bennett Island and dated November 8, 1902. It is as follows:

In company with the astronomer, F. G. Seeberg, and two hunters, the Tungus Nicholas Diakonoff and the Yakut Vassili Gorokhoff, on June 7, I left the winter harbor of the *Zarya* (Nerpichiya Bay of Kotelnyi Island). We followed the northern coasts of Kotelyni and Thadéeff Islands, keeping our course towards Cape Visoki on New Siberia. On June 13 I took the course towards Bennett Island. The ice was pretty broken. On June 25, three miles from Cape Visoki, the ice was definitely broken. Preparing to take to our *baidaras* [leather boats], we killed our last dogs. From here we were carried on an ice-floe, for four and a half days, 48 miles in the desired direction. Then, having noticed that our ice-floe had drifted 10 miles southwards, we left it on July 31, and after having covered the remaining 23 miles in our *baidaras,* landed on August 3 on Bennett Island, at Cape Emma.

According to the survey of Seeberg, who has also determined the magnetical elements both here and on the journey—in ten places in all—Bennett island is a plateau, not higher than 1,500 feet. By its geological structure it appears as a continuation of the plateau of Middle Siberia, which is built up, here also, of very ancient marine deposits (Cambrian), pierced by irruptions of basalt. In places one finds, under the sheets of basalt, deposits of brown coal with relics of vegetation, namely conifers. In the valleys of the island, bones of mammoths and other Quaternary-period animals, washed out of the deposits, are found occasionally.

As to the present inhabitants of Bennett Island, they are, besides the temporary visitor, the walrus, the polar bear and the reindeer. A herd of some thirty of the latter wandered on the rocky feeding-ground of the island. We fed upon them, and made out of their skins the fur cloth and the boots required for the winter journey. The following birds stay here: two species of *Somateria,* one sandsnipe, one bullfinch and five species of gulls, including the roseate one.

As for migratory birds, we saw one eagle which flew south to north, one falcon which flew north to south, and geese whose flock went also north to south. Owing to fogs, we could not see the land wherefrom these birds came; neither could we see Sannikoff's Land, any more than during our last navigation.

We are going to leave here the following instruments: a reflecting circle with artificial horizon, a Krause's inclinator, the anemometer, the photographic apparatus 'Norah,' and some others.

To-day we are going southwards. We have provisions for fourteen to twenty days. All in good health. 76° 38′ N. lat., 149° 42′ E. long.

SCIENTIFIC NOTES AND NEWS.

LORD KELVIN celebrated his eightieth birthday on June 26.

MR. W. H. M. CHRISTIE, the astronomer royal, and Sir David Gill, of the Cape Observatory, have been elected corresponding members of the Paris Bureau des Longitudes.

THE University of Manchester has conferred the doctorate of science on Professor Bohuslav Brauner, Ph.D., of the Czech University of Prague, Mr. Ludwig Mond, F.R.S., and Mr. W. H. Perkin. Professor Dixon, in making the presentations, said Dr. Brauner was an old student of this university, and one of

Mendeléef's most distinguished disciples. Dr. Mond had almost realized the dream of the alchemist of transmuting common things into gold. Dr. Perkin had extracted from coal tar a whole spectrum of colors, and was, since Faraday's time, the man who had followed most deeply the vibrations of light as they penetrate molecules.

M. A. Chauveau, professor at the Paris Museum of Natural History, has been elected director of the Marey Institute for Physiology in the room of the late M. Marey.

The Scottish Geographical Society has awarded its Livingstone gold medal to Commander Robert Scott, leader of the British Antarctic Expedition, and the society's gold medal to Mr. W. S. Bruce, leader of the Scottish Antarctic Expedition.

Professor Ernest F. Nichols, of the department of physics in Columbia University, has sailed for Europe and will spend next year in work at Cambridge, Berlin and Paris.

Miss W. J. Robinson, instructor in biology in Vassar College, and Miss M. M. Brackett have gone to the Cinchona Laboratory of the New York Botanical Garden to carry out some embryological investigations. Mr. G. W. Collins, of the U. S. Department of Agriculture, Mr. Wm. R. Maxon, of the U. S. National Museum, and Mr. Louis Agassiz Fuertes, of Ithaca, New York, have also recently carried out certain studies at Cinchona.

Professor Clara E. Cummings, of Wellesley College, has been granted a sabbatical year, which will be spent in resting and studying the tropical flora. Associate Professor Furguson will have charge of the department for the year.

Professor James Geikie has been elected president of the Scottish Geographical Society in succession to Sir John Murray.

An Association for the Relief, Control and Prevention of Tuberculosis has been established at Newport, R. I., with Mr. Robert Frame as president.

Dr. W. Schottler, of Maintz, has been appointed geologist in the Geological Institute at Darmstadt.

Lord Avebury was reelected president of the Ray Society at the annual meeting on June 9. The other officers are: *Vice-Presidents,* Dr. R. Braithwaite, Mr. A. D. Michael and Lord Walsingham, F.R.S.; *Treasurer,* Dr. DuCane Godman, F.R.S.; and *Secretary,* Mr. John Hopkinson.

Mr. Francis Edward Macmahon, inventor of the telegraph tape machine known as the 'ticker,' died in England on July 5. He served in the United States navy during the civil war, and was in Admiral Farragut's flagship at the taking of New Orleans. Subsequently he settled in England, and of late years patented many inventions, ranging from a tap to a chainless bicycle.

The United States Civil Service Commission announces an examination on July 27, 1904, to secure eligibles from which to make certification to fill a vacancy in the position of mechanician in the Bureau of Standards, at $900 per annum, and other similar vacancies as they may occur in that bureau. No educational test will be given, and it will not be necessary for applicants to appear at any place for examination. The appointee must have had five years' shop experience, two of which must have been spent in a shop in which scientific instruments were constructed.

Professor M. Ascoli, president of the Associazione Elettrotecnica Italiana, writes to the *Electrical World* that no fewer than 41 members have already formally engaged themselves for the trip to America, arriving in two parties about August 24–25. The official representatives will be Professor Ascoli and the two vice-presidents, Professor G. Brasi, of Turin, and Professor L. Lombardi, of Naples. The delegates of the Italian Government to the Electrical Congress will be Professor Ascoli on behalf of the Ministry of Posts and Telegraphs, and Professor Lombardi, for the Ministry of Public Instruction.

The Journal of the American Medical Association states that the date set for the next session of the American Medical Association is July 11–14, 1905. This date has been decided on after considerable correspondence. The holiday season for the majority of medical

men is from about the first week in July to September, and the schools have by that time all closed. Most of those who live in the east will want to utilize the trip to the association meeting as their summer vacation, and if the date were that usually adopted for the association meeting, these would not be able to attend. In July Portland has a delightful climate, and consequently there need be no fear of hot weather.

WE also learn from the *Journal of the American Medical Association* that the American Society of Tropical Medicine has been incorporated in Philadelphia. The officers are: *President,* Dr. Thomas H. Fenton, Philadelphia; *vice-presidents,* Dr. James Anders, Philadelphia, and Dr. I. G. Kinyon, Glenolden, Pa.; *secretary,* Dr. Joseph McFarland, Philadelphia; *assistant secretary,* Dr. John M. Swan, Philadelphia; *treasurer,* Dr. Wharton Sinkler; council: Drs. R. G. Curtin, Judson Daland, Allen J. Smith, and W. M. L. Coplin. The men elected to honorary membership for valuable research work in the prevention of tropical diseases are: Surgeon-General William H. Forwood; Rear-Admiral Surgeon P. M. Rixey, Dr. Walter Wyman, Sir Patrick Manson of England, Dr. A. Laveran of the Pasteur Institute, France; Professor Robert Koch, Germany; Professor Charles J. Martin, Sydney, N. S. W.; Professor Aristides Agramonte, University of Havana, Cuba; Dr. Frederick Montazambert, chief health officer of the Dominion of Canada; Professor Kitasato, University of Tokio, and Professor Eduardo Liceaga, head of the department of health, Mexico.

THE Board of Estimate of New York City has appropriated $10,000 to pay the expenses of a commission of medical experts to pass on the question whether or not pneumonia is a contagious disease.

THE Emperor Francis Joseph laid on June 21 the foundation stone of the new General and University Hospital for Vienna, to replace the old general hospital built 120 years ago.

IT is announced that if sufficient support can be secured it is intended to publish from the office of *The Journal of Medical Research,* Boston, an atlas of bacterial infections in man. It will consist of one hundred plates—a few in color—with descriptive text. The reproductions will be ten by twelve inches, a large number of them with but one figure on a plate, printed on heavy paper and in the best manner. The volume will be furnished bound in half morocco, and copies will be numbered, for the edition will be limited. The price will be ten dollars delivered free in the United States and Canada. The authors will be Dr. H. C. Ernst, professor of bacteriology in the Harvard Medical School, and Dr. S. B. Wolbach, first assistant resident pathologist to the Boston City Hospital.

MR. W. W. CANADA, consul at Vera Cruz, Mexico, writes that an agitation has been on foot for some time looking to the passage of a law to prevent the wanton destruction of birds throughout Mexico; in fact, a proposed law has already been presented to the government by the Association for the Protection of Birds, and it is confidently expected that it will meet the approval of the executive. This law is intended to prevent the killing of certain classes of birds useful to the agriculturist. Other kinds, such as for instance game birds, may be killed only at stated periods of the year. All birds of prey, and others destructive to the interests of the farmer, may be killed at any time and by anybody. Such a law, if rigidly enforced, can not fail to be of great benefit to the people of the United States, as for instance in the case of migratory birds that winter in Mexico, or even farther south, and that return to the north in the proper season if not killed off in the meantime.

A WILD Birds Protection Acts Amendment (St. Kilda) Bill has been introduced in the British parliament by Sir Herbert Maxwell. To it is prefixed the following explanatory memorandum: "By section 9 of the Wild Birds Protection Act, 1880, it was provided that the operation of that act should not extend to the island of St. Kilda. The object of this bill is by extending the protection afforded by that act to St. Kilda to provide means for saving the St. Kilda wren and other

birds, which are becoming rare from the extermination with which they are threatened. It is proposed to exempt certain birds from the schedule to the act of 1880 as being required for the support of the inhabitants of the island." Protection is given by the bill to the fork-tailed petrel, in addition to the St. Kilda wren, and the birds to be exempted from the schedule of the act of 1880, so far as regards the island of St. Kilda, are the fulmar, gannet, guillemot, puffin and razorbill.

In the Hawaiian Islands it is now recognized that forest preservation is a matter of great and immediate importance to the leading economic interests of the territory. The chief agricultural interest of the islands is sugar growing. In 1903 the exported sugar was valued at $25,310,684, or 96 per cent. of the total exports. The supply of water on which successful cane cultivation depends comes to a large extent from the forested higher slopes of the mountains, above the plantations. But the situation is complicated by the fact that cattle raising, which in economic importance stands second only to the sugar industry, depends largely on the use of the forest for range, and overgrazing has been the principal cause of injury to the water-holding power of the wooded area. As a preliminary to the formulation of a policy in the interest of the islands as a whole, the territory a year ago asked for an examination of the whole question on the ground by an agent of the United States Department of Agriculture. The report of Mr. William L. Hall, of the Bureau of Forestry, who made the examination, is now being printed as Bulletin No. 48, 'The Forests of Hawaii.' Both from a scientific and practical standpoint it gives much information concerning these Hawaiian forests and their uses. The conflict of interests between the cattlemen and the sugar planters is evident, but need not seriously menace rehabilitation of the forests. The cattle-men in many instances desire the forests for pasturage. The planters rightly contend for the intact forest with perfect floor cover to secure the greatest possible storage of water for the supply of growing crops. But the clashing of interests is happily reduced by other conditions, chief of which is that sugar growing is the great sustaining industry and the dominant source of income. An additional potent fact is that many cattle raisers are also sugar growers, and their double interests compel them to take the broadest view of the needs of the islands as a whole. The Bureau of Forestry has supplied the islands with a forester, and is actively cooperating with the territorial authorities in all matters of policy.

The Interstate Commerce Commission reports that the total number of casualties to persons on the railways of the United States for the year ending June 30, 1903, was 86,393, of which 9,840 represented the number of persons killed and 76,553 the numbered injured. Casualties occurred among three general classes of railway employees, as follows: Trainmen, 2,070 killed and 25,676 injured, switch tenders, crossing tenders, and watchmen, 283 killed, 2,352 injured; other employees, 1,253 killed, 32,453 injured. The casualties to employees coupling and uncoupling cars were, employees killed, 281; injured, 3,551. For the year 1902 the corresponding figures were, killed, 167; injured, 2,864. The casualties connected with coupling and uncoupling cars are assigned as follows: Trainmen killed, 211; injured, 3,023; switch tenders, crossing tenders and watchmen killed, 57; injured, 416; other employees killed, 13; injured, 112. The casualties due to falling from trains, locomotives or cars in motion were: Trainmen killed, 440; injured, 4,191; switch tenders, crossing tenders and watchmen killed, 39; injured, 461; other employees killed, 72; injured, 536. The casualties due to jumping on or off trains, locomotives or cars in motion were: Trainmen killed, 101; injured, 3,133; switch tenders, crossing tenders and watchmen killed, 15; injured, 279; other employees killed, 82; injured, 508. The casualties to the same three classes of employees in consequence of collisions and derailments were: Trainmen killed, 648; injured, 4,526, switch tenders, crossing tenders and watchmen killed, 17; injured, 137; other employees killed, 128; injured, 743. The number of passengers killed in the course of the

years 1903 was 355, and the number injured 8,231. In the previous year 345 passengers were killed and 6,683 injured. There were 173 passengers killed and 4,584 injured because of collisions and derailments. The total number of persons, other than employees and passengers, killed was 5,879; injured, 7,841. These figures include the casualties to persons classed as trespassing, of whom 5,000 were killed and 5,079 were injured. The total number of casualties to persons other than employees from being struck by trains, locomotives or cars, were 4,534 killed and 4,029 injured. The casualties of this class were as follows: At highway crossings, passengers killed, 3; injured, 7; other persons killed, 895; injured, 1,474; at stations, passengers killed, 24; injured, 108; other persons killed, 390; injured, 501; at other points along track, passengers killed, 8; injured, 14; other persons killed, 3,214; injured, 1,925. The ratios of casualties indicate that 1 employee in every 364 was killed, and 1 employee in every 22 was injured. With regard to trainmen—that is, enginemen, firemen, conductors and other trainmen—it appears that 1 trainman was killed for every 123 employed, and 1 was injured for every 10 employed. One passenger was killed for every 1,957,441 carried, and 1 injured for every 84,424 carried. With respect to the number of miles traveled, however, the figures show that 58,917,645 passenger-miles were accomplished for each passenger killed, and 2,541,096 passenger-miles for each passenger injured.

THE council and officers of the Institution of Civil Engineers gave a dinner on June 19 at the Grand Hotel to the president, Sir William H. White. Among those present were Sir Guilford L. Molesworth (in the chair), Lord Kelvin, Sir Benjamin Baker, Professor Sir James Dewar and Sir William H. Preece.

THE Paris papers of June 22 publish accounts of the 'le fête du soleil'—a sort of modern sun-worship function held in the Eiffel tower in Paris on the night of June 21. *Le Matin* of June 22 says that M. Janssen was the high priest of the occasion, and that an address 'd'une effrayante erudition' was delivered by M. Flammarion. At half past twelve the assemblage mounted to the summit of the tower to 'assist' at the rising of the sun. The paper remarks that "the ceremony was a calm and dignified one which the moon lit up without jealousy. For though it be stoutly and most learnedly affirmed that there was no night, it is none the less true that if one could see clearly it was on account of the moon, not to mention electricity."

IT is stated in *Nature* that the twenty-second congress of the Sanitary Institute will be held in Glasgow from July 25–30, under the presidency of Lord Blythswood. Sir Richard Douglas Powell, Bart., K.C.V.O., will deliver the lecture to the congress on 'The Prevention of Consumption.' It appears from the program that 250 authorities, including several county councils and county boroughs, have already appointed delegates to the congress, and as there are more than 3,300 members and associates in the institute, there will probably be a large attendance in addition to the local members. In connection with the congress, a health exhibition of apparatus and appliances relating to health and domestic use will be held as practical illustration of the application and carrying out of the principles and methods discussed at the meetings. Popular lectures will be given in the exhibition on physical development, by Dr. P. Boobbyer; care of eyesight, by Dr. James Kerr; care of the teeth, by Mr. G. Cunningham; feeding and digestion, by Professor A. Bostock Hill; and healthy houses, by Professor H. R. Kenwood. The sections and their presidents are: (1) Sanitary science and preventive medicine, Professor J. Glaister; (2) engineering and architecture, Professor H. Robinson; (3) physics, chemistry and biology, Professor Frank Slowes. There will be eight special conferences, the subjects and presidents of which will be as follows: Municipal representatives, Mr. W. F. Anderson; industrial hygiene, Mr. J. Steele; medical officers of health, Sir C. A. Cameron, C.B.; engineers and surveyors to county and other sanitary authorities, Mr. W. Weaver; veterin-

ary inspectors, Professor James McCall; sanitary inspectors, Mr. T. F. Strutt; women on hygiene, the Duchess of Montrose; the hygiene of school life, Professor John Edgar.

UNIVERSITY AND EDUCATIONAL NEWS.

We learn from the London *Times* that the Schunck Laboratory, bequeathed to Owens College by the late Dr. Schunck, who had in his lifetime endowed the college with £20,000 on behalf of chemical research, has been removed from his residence at Kersal and rebuilt in the college precincts as nearly as possible in its original form. It comprises two floors and a basement, with the most modern appliances, also a valuable library and a collection of coloring matter, natural and artificial. Dr. Perkin, who assisted Dr. Schunck in the development of alizarin, performed the ceremony of opening the laboratory in its new home on July 1. Mrs. Schunck presented, through her son Mr. Charles Schunck, a medallion portrait of her late husband, which has been placed in the laboratory.

Members of the graduating class of Harvard University expect to pursue work as follows:

Business	128
Law	121
Teaching	68
Scientific pursuits	68
Medicine	20
Railroading	14
Architects	12
Ministry	8
Journalism	7

The fact that ten times as many students expect to follow scientific pursuits as will enter the ministry witnesses a great change that has taken place within recent years.

The relation that the evolutionary theory as originally laid down by Darwin has come to have in what would once have been regarded as widely removed fields was specially considered by the zoological department of the University of Michigan the second half of this college year. The course was supplementary to the course on organic evolution, and aimed to give a critical appreciation of the development of the evolution theory since Darwin, and of the bearing of that development on various fields of knowledge. The theory of evolution has so profoundly influenced psychology, ethics and social science, to say nothing of other subjects, that an acquaintance with the ground and import of this theory is a necessary part of the equipment of the student in any of these fields, as well as of the biologist, who has an interest in the broader aspects of his work. It was the purpose of the course to give the student the necessary basis for appreciating in some degree the import of biology. Somewhat more than half the time was devoted to organic evolution, particularly to its post-Darwinian developments, while the remainder was devoted to the evolution of the behavior of the lower animals and of man, and to social and ethical evolution. The course was conducted by different members of the zoological staff, each dealing with those aspects of the subject to which he has devoted especial attention.

At the June meeting of the trustees of Western Reserve University the following appointments were made in the Medical Department: Torald Sollman, professor of pharmacology and materia medica; Frederick Clayton Waite, associate professor of histology and embryology; Roger G. Perkins, assistant professor of bacteriology and pathology; Percy W. Cobb, demonstrator in physiology; E. D. Brown, demonstrator in pharmacology and materia medica; J. B. Austin, demonstrator in histology and embryology. The following gifts were received during the year: For the endowment of Harry Willson Payne Professorship, $100,000; for the Adolph Cudell Library fund, $200; for current budget expenses, $5,000.

Professor Howard J. Banker, of the Southwestern Normal College of Pennsylvania has been elected professor of biology in DePauw University at Greencastle, Indiana.

Professor Georg Gaffky, professor in the University of Giessen, has accepted a call to occupy the chair vacant through the resignation of Dr. Robert Koch, in the University of Berlin.